THE PUNCHBOWL: HONOLULU'S METROPOLITAN VOLCANO

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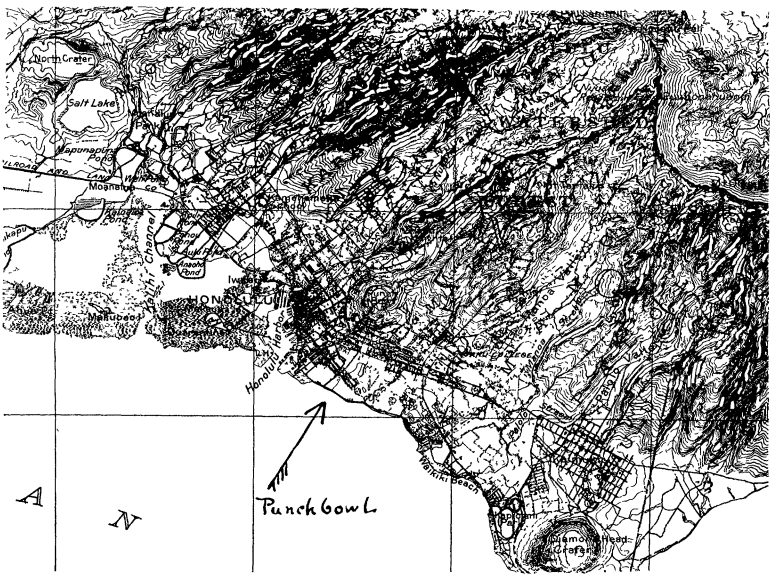
HONOLULU, capital of Hawaii and strategic center of the north Pacific Ocean, is widely known as a tropical tourist resort, and as a great American naval station. The city has spasmodically expanded from an aboriginal cluster of grass huts to a cosmopolitan metropolis of sixty thousand people. It now stretches loosely along eight miles of the narrow coastal plain which lies between the mountains and the sea. The plain is of coral origin and rests upon the submarine flanks of the deeply carved volcanic mass that forms the bulk of the island. Scattered here and there over the plain are numerous craters that were thrown up by the final convulsions of the plutonic island-builders. These igneous disturbances ceased long ago and apparently are extinct. The silent craters remain as grim testimony of Oahu's prehistoric epoch of fire. Among the best preserved of these crater-hills is old "Punchbowl," a remarkable volcano lying in the very heart of Honolulu and commanding a magnificent view of the city and its lovely environs.

The Hawaiian name for this venerable crater is *Pu-o-waina* and it has a tragic significance. The original form, from which the modern spelling is abbreviated, was *Puu o waiho ana,* literally the hill of offering or sacrifice. The people of primitive Hawaii were dominated by the dreadful *tabu* system that once ruled all Polynesia. The penalty for any violation of its intricate regulations was death. *Pu-o-waina* was one of the places near Honolulu where the bodies of the offenders were ceremoniously burned. Near the highest point on the seaward rim is a flat, altar-like ledge. Below this ledge is a crack or orifice, once a volcanic vent. This gave a good draft of air and added to the suitability of the place for a sacrificial altar. Like place-names in all parts of the world, *Pu-o-waina* lingers for generations after the extinctions of the practises that once made it so effective.

In shape and structure Punchbowl is a fine example of a truncated volcanic hill produced by explosion. By truncated is meant, not that its top was ever blown off, but that it never possessed a sharply conical point or peak. From the time of its formation its top has been a bowl-shaped depression. The crater walls are composed of brown volcanic mud or tufa, which was violently ejected in a single titanic explosion.

The huge column of superheated steam-charged mud and rock-stuff tore through the soft coral plain, shot to dizzy aerial heights, and dropped back around its vent. Thus was produced the symmetrical rim and bowl, and hence the name Punchbowl. There are numerous extinct volcanoes on Oahu and other Hawaiian islands that were formed in this same manner, and that with equal appropriateness might claim the fanciful title of Punchbowl.

The elevated coral plain up through which Punchbowl exploded is here about fifty feet above sea-level. The highest point of the crater is about five hundred feet (498) above the sea. The total diameter of the hill, including the basal slopes, is a full mile. The "bowl" has a rim-to-rim diameter of 2,200 feet from north to south, and 1,800 feet from east to west. The marked difference in the two diameters is shared with the other Hawaiian volcanoes of this type and is due to the wind



MAP OF HONOLULU, SHOWING THE LOCATION OF PUNCHBOWL.

conditions that existed at the time of the eruption. The usual winds of this part of the North Pacific in which the Hawaiian Archipelago is situated are the well-known trade-winds. These blow steadily from the northeast practically throughout the year. The trade-winds are so constant that the majority of the explosive cones are conspicuously one-sided. The strong wind deflected the eruptive column of volcanic mud. Consequently the bulk of the ejected material was dropped on the leeward, or southeast, side of the vent.

Punchbowl, however, is a striking exception to this prevalent elongation of crater axis in the direction of the trade-wind. It so happened

VIEW FROM PUNCHBOWL ON THE LOWLANDS. Diamond Head in the distance.

that just at the time of the Punchbowl explosion the dominant wind was not the trade, but the southeast, or "Kona," wind. This Kona wind blows erratically at infrequent intervals, mainly during the rainy season. The configuration of Punchbowl clearly shows that a strong Kona wind warped the erupted column to the northwest, and caused the deposits to fall chiefly on that side.

Several excellent automobile roads cut spirally around the furrowed sides of Punchbowl, through low gaps in the crumbling rim, and finally circle the basin floor. The basin has a depth of about one hundred and fifty feet. Its monotonous interior is covered with a sparse and stunted growth of such thorny plants as prickly-pear cactus, lantana, algarona, and *klu*. The lower part of the basin, that benefits most from the scant interior drainage, supports a thin grove of the algaroba, or *kiawe*, trees. Cattle and goats roam freely through the crater. On several occasions the bowl has been surveyed as a reservoir site, but other more favorable localities have been chosen. Since the military occupation of Oahu by federal troops, the commanding position of Punchbowl has recommended it as a location for batteries. In the days of the Hawaiian monarchy several small brass cannon were mounted on the brow of the hill, but these were removed many years ago. The basin is now being used as a rifle-range by the local militia. The slopes may some day mask the formidable artillery of Oahu's coast defense.

The outer slopes of Punchbowl are broadly scored by regular flutings or corrugations, the tooth-marks of long-continued erosion. These flutings and the numerous stone quarries make graphic sections and clearly reveal the structure of the walls. The tufa was deposited in well-defined layers of varying thickness, and permeated with coral lime. The layers strikingly show the double quaquaversal dip characteristic of volcanoes

of this class; their average angle is about twenty-five degrees. The quarries occur here and there along the lower skirts of the hill. The soft, easily-worked tufa has proved to be an excellent road material. Most of the streets and roadways in the vicinity are made wholly of tufa.

On the Punchbowl slopes one finds great quantities of a cinder-like volcanic ash. This is locally called "black sand." It occurs in extensive sheets over the Honolulu plain. The interior of Punchbowl crater is lined with this ash. A short distance eastward is a hill two hundred feet high, composed wholly of black sand. These evidences all point to a long series of stupendous black sand eruptions that devastated this region just as Vesuvius entombed Pompeii and Herculaneum. Some of the ash was ejected by Punchbowl, the remainder was discharged from other volcanoes in the neighborhood.

A very interesting glimpse into the geological history of Punchbowl has been afforded by an artesian well-boring near its flanks. The shaft first penetrated ten feet of black sand; then thirteen feet of *coral,* and finally about fifty feet of tufa. This succession shows that the crater was thrown up in relatively shallow water, coral reef grew over its flanks, and the reef in turn was covered by the volcanic ashes. The crater obviously was formed before the recent elevation of the Honolulu plain above the sea-level. According to Dr. Sereno E. Bishop the great symmetry and uniformity of Punchbowl's rim indicates that the crater was ejected in a *single rapid out-throw,* probably lasting a very few hours! He gives as the conjectural time of this explosion a period about 45,000 years ago.

Honolulu has steadily encroached upon the once-barren slopes of the volcano. In the early days Punchbowl was a remote outskirt, isolated

VIEW FROM PUNCHBOWL ALONG THE LOWLANDS AT THE FOOT OF THE MOUNTAINS.

A STEEP TRAIL UP THE TUFA SLOPES OF PUNCHBOWL. The summit is 200 ft. above the observer.

by dry plains from the tiny grass-thatched settlement on the beach. To-day its base underlies an important residence section in the center of the city. The Territorial Normal School is located on its seaward slope. The thrifty Portuguese, skilled in the gardening of Madeira's steep farmsteads, settled as easily and comfortably upon the arid walls of Punchbowl as did the amphibious Chinese upon the marshy rice-lands. The small, well-pruned gardens of "Portuguese Town" are crowded with luxuriant trees and shrubbery—figs, pomegranates, citrus and mango trees, grape-vines, avocadoes, papaias, bananas, and many other useful and ornamental plants.

A superb panorama of the surrounding country is visible from the rim of this city-girt hill. The distant purple Waianæ Range, the Wahiawa pineapple lands, glimpses of Pearl Harbor and the Kalihi channel, bowery Honolulu reposing beneath its rich canopy of tropical foliage, the valley floors bright with rice and taro, the long ridges rising into the cloud-capped mountains, the friendly palms of Waikiki beach, old Diamond Head bleached and gray against the brilliant blue of the seaward sky, the rusty red Kaimuki region, and, mountainward, the forested slopes of Tantalus: these compose a variegated picture of unique and lasting charm.

Equally rich and memorable is a tranquil moonlit evening on Punchbowl's rim. The gaunt, moon-bathed crater walls fade into the twinkling scattered lights of the city; the hushed air throbs with the roll of distant surf; the odorous trade-wind pours down from the shadowy mountains; tropic fragrances rise from the white-fenced gardens; these quiet beauties, subtly blended by the moonlight, bring a new appreciation of this ancient hill of fire and sacrifice.